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Claims

1. System for influencing the induction gas temperature and thereby the energy level in the combustion chamber (12) of an internal combustion engine (10), especially an HCCI-enabled internal combustion engine (10), with

- a compression device (16) to compress induced fresh air, which before compression has a temperature T1, as well as
- expansion means (18), which cause an expansion of the compressed induced fresh air,
- with the compressed and subsequently expanded fresh air having a temperature T2 > T1,

characterized in that
a temperature sensor (20) to record the temperature T2 is arranged in the direction of flow of the fuel/air with reference to the expansion means, so that this can be taken into account within the framework of regulating the induction gas temperature.

2. System in accordance with claim 1,
characterized in that
an exhaust gas recirculation device is provided to feed exhaust gas from an earlier combustion cycle to fresh air or to a mixture featuring fresh air, in order to provide an air/fuel/exhaust gas mixture with an advantageous energy level for combustion after injection of fuel.

3. System in accordance with claim 1 or 2,
characterized in that
the compression device is an exhaust gas turbocharger (16).

4. System in accordance with on of the previous claims, characterized in that the compression device is a compressor.

5. System in accordance with on of the previous claims, characterized in that the expansion is performed on a throttle valve (18).

6. system in accordance with one of the claims 2 and 5, characterized in that

- at least one heat exchanger operating as an exhaust gas cooler (32) is provided for reducing the temperature of the recirculated exhaust gas, and

- a coolant setting valve (50) is provided, so that the induction gas temperature can be set or regulated by influencing the coolant throughflow through the exhaust gas cooler (32) taking into account measured values or values determined on the basis of technical models.

7. System in accordance with on of the previous claims, characterized in that the exhaust gas cooler (32) is arranged in a separate heat exchanger circuit (46).

8. System in accordance with on of the previous claims, characterized in that the exhaust gas cooler is arranged in an engine coolant circuit.

9. System in accordance with on of the previous claims, characterized in that the exhaust gas cooler is designed as an engine or transmission oil heat exchanger respectively.

10. System in accordance with on of the previous claims,

characterized in that
the measured values or the values determined in accordance with technical models are assigned to at least one of the following variables

- Exhaust gas temperature,
- Recirculated exhaust gas mass or quantity respectively,
- Air/fuel temperature,
- Air/fuel mass or quantity respectively,
- Induction gas temperature,
- Induction gas mass or quantity respectively,
- Coolant temperature or oil temperature of the coolant or oil flowing through the exhaust gas cooler and
- Coolant mass or oil mass or coolant quantity or oil quantity of the coolant or oil flowing through the exhaust gas cooler.

11. System in accordance with on of the previous claims,
characterized in that
a temperature sensor (20) to record the air/fuel temperature, a temperature sensor (24) to record the exhaust gas temperature at the engine exhaust, an air mass or quantity measurement device respectively (28) to record the air/fuel mass or quantity and an exhaust gas mass or quantity measuring device (28) to record the exhaust gas mass or quantity are provided.

12. System in accordance with on of the previous claims,
characterized in that
the induction gas temperature is calculated in accordance with equation

$$T_{ASG} = \frac{\dot{m}_{FG} T_{FG} C_{p,FG} + \dot{m}_{AG} T_{AG} C_{p,AG}}{\dot{m}_{FG} C_{p,FG} + \dot{m}_{AG} C_{p,AG}}$$

with

$\dot{m}_{FG}$: Air/fuel mass flow

$\dot{m}_{AG}$: Exhaust gas mass flow

T_{FG}: Air/fuel temperature

T_{AG}: Exhaust gas temperature

T_{ASG}: Induction gas temperature

$c_{p,FG}$: Heat capacity of the air/fuel mixture

$C_{p,AG}$: Heat capacity of the exhaust gas.

13. System in accordance with on of the previous claims, characterized in that the exhaust gas temperature at the heat exchanger outlet is calculated using the following equation system:

$$\left|\Delta\dot{Q}_{KM}\right| = \left|\Delta\dot{Q}_{AG}\right| = \dot{Q}_{WT}$$

$$\Delta\dot{Q}_{KM} = \dot{m}_{KM} C_{p,KM} \left(T_{KM,OUT} - T_{KM,IN}\right)$$

$$\Delta\dot{Q}_{AG} = \dot{m}_{AG} C_{p,AG} \left(T_{AG,IN} - T_{AG,OUT}\right)$$

$$\dot{Q}_{WT} = kA\Delta T_m$$

with

$\dot{Q}$: Heat flow

KM: Coolant

AG: Exhaust gas

WT: Heat exchanger

C_p: Heat capacity

k: Heat transfer coefficient of the heat exchanger

A: Heating surface of the heat exchanger

ΔT_m Mean logarithmic temperature difference.

14. Method for influencing the induction gas temperature and

thereby the energy level in the combustion chamber (12) of an internal combustion engine (10), especially an HCCI-enabled internal combustion engine, in which

- induced fresh air, which before compression has a temperature T1, is compressed and
- the compressed induced fresh air is expanded,
- with the compressed and subsequently expanded fresh air having a temperature T2 > T1,

characterized in that
the temperature T2 is recorded after the expansion, so that this can be taken into account within the framework of a regulation of the induction gas temperature.

15. Method according to Claim 14,
characterized in that
exhaust gas from an earlier combustion cycle is fed into fresh air or into a mixture featuring fresh air respectively, in order to provide, after fuel has been injected, an air/fuel/exhaust gas mixture with an energy level advantageous for combustion.

16. Method in accordance with Claim 14 or 15,
characterized in that
the compression is performed by an exhaust gas turbocharger (16).

17. Method in accordance with one of the Claims 14 to 16,
characterized in that
the compression is performed by a compressor.

18. Method in accordance with one of the Claims 14 to 17,
characterized in that
the expansion is performed on a throttle valve (18).

19. Method in accordance with one of the Claims 15 to 18, characterized in that

- exhaust gas is cooled in a heat exchanger operating as an exhaust gas cooler (32) for reducing the temperature of the recirculated exhaust gas, and

- by influencing the coolant throughflow through the exhaust gas cooler (32) by means of a coolant setting valve (50) taking into account measured values or values determined from technical models, the induction gas temperature is set or regulated respectively.

20. Method according to Claim 19, characterized in that the measured values or the values determined in accordance with technical models are assigned to at least one of the following variables:

- Exhaust gas temperature,
- Recirculated exhaust gas mass or quantity respectively,
- Air/fuel temperature,
- Air/fuel mass or quantity respectively,
- Induction gas temperature,
- Induction gas mass or quantity respectively,
- Coolant temperature or oil temperature of the coolant or oil flowing through the exhaust gas cooler and
- Coolant mass or oil mass or coolant quantity or oil quantity of the coolant or oil flowing through the exhaust gas cooler.

21. Method in accordance with Claim 19 or 20, characterized in that the air/fuel temperature, the exhaust gas temperature at the engine exhaust, the air/fuel mass or quantity respectively and

the exhaust gas mass or quantity respectively are measured.

22. Method in accordance with one of the Claims 19 to 21, characterized in that the induction gas temperature is calculated in accordance with equation

$$T_{ASG} = \frac{\dot{m}_{FG} T_{FG} C_{p,FG} + \dot{m}_{AG} T_{AG} C_{p,AG}}{\dot{m}_{FG} C_{p,FG} + \dot{m}_{AG} C_{p,AG}}$$

, with

$\dot{m}_{FG}$:	Air/fuel mass flow
$\dot{m}_{AG}$:	Exhaust gas mass flow
T_{FG}:	Air/fuel temperature
T_{AG}:	Exhaust gas temperature
T_{ASG}:	Induction gas temperature
$c_{p,FG}$:	Heat capacity of the air/fuel mixture
$C_{p,AG}$:	Heat capacity of the exhaust gas.

23. Method in accordance with one of the Claims 19 to 22, characterized in that the exhaust gas temperature at the heat exchanger outlet is calculated using the following equation system:

$$\left|\Delta\dot{Q}_{KM}\right| = \left|\Delta\dot{Q}_{AG}\right| = \dot{Q}_{WT}$$

$$\Delta\dot{Q}_{KM} = \dot{m}_{KM} C_{p,KM} \left(T_{KM,OUT} - T_{KM,IN}\right)$$

$$\Delta\dot{Q}_{AG} = \dot{m}_{AG} C_{p,AG} \left(T_{AG,IN} - T_{AG,OUT}\right)$$

$$\dot{Q}_{WT} = kA\Delta T_m$$

with

$\dot{Q}$: Heat flow

KM: Coolant

AG: Exhaust gas

WT: Heat exchanger

C_p: Heat capacity

k: Heat transfer coefficient of the heat exchanger

A: Heating surface of the heat exchanger

ΔT_m Mean logarithmic temperature difference.